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A Study of Low-Thrust Guidance Methods

UNPUBLISHED PRELIMINARY DATA

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The proposed study has as its objective the comparison and evaluation of existing methods and the development, where necessary, of new methods for guiding low-thrust space vehicles on interplanetary transfer missions. The preliminary portion of the study has been devoted to comparing two existing deterministic guidance methods. The two methods under study are the Lambda Matrix Control Scheme¹ and the Extremal Field Control Scheme.^{2,3}

Present State of Investigation

As reported in Ref. 4, the steepest ascent optimization scheme is not readily adapted to computing the reference trajectories for the low-thrust transfer. Present efforts to remedy this problem include: (1) efforts to determine the optimal weighting matrix for the steepest ascent trajectory in order to accelerate convergence and (2) investigation of a method discussed by Jazwinski.⁵ The second method has the advantage that the control program on all trajectories satisfies the necessary Euler equations for an optimal trajectory. The steepest ascent trajectory will satisfy these conditions only after convergence to the true optimum is attained.

The generation of the Lambda Matrix Control Scheme data has been completed. Numerical results for a 180-day transfer have been

problems encountered in this region will be more critical than the requirements encountered in heliocentric space.

4. The initiation of work on simulating the behavior of the control schemes when they are subjected to random observation errors and random errors in the application of the prescribed control deviation.

It is anticipated that a final report covering the first two of these items will be completed by February 1, 1965.

References

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5. Jazwinski, A. H., "Optimal Trajectories and Linear Control of Nonlinear Systems," AIAA Journal, Vol. 2, No. 8, August 1964, p 1371.